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THE INFLUENCE OF BARLEY ON THE MILK SECRETION OF COWS

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THE INFLUENCE OF BARLEY ON THE MILK SECRETION OF COWS

By F. W. WOLL and E. C. VOORHIES

Barley is one of the standard feeds for horses, cattle, hogs and sheep in this state, as in most of the Western states, and is also frequently used as a part of the grain rations for dairy cattle and poultry. There is a certain prejudice against the use of this cereal for milch cows among some dairy farmers, who believe that it has a tendency to dry up the cows, but the nutritive effect of the cereal and its high value for stock feeding are otherwise generally recognized by our farmers. The influence of barley on the milk secretion of cows in the University dairy herd has been studied during the past few years and the results of this investigation are given in the following pages.

EXPERIMENTS WITH GRADE HOLSTEIN

In taking up this question for study, it was decided to feed barley as the sole concentrate to a good type of a dairy cow for several lactation periods, in addition to alfalfa hay or alfalfa and silage. The plan was to feed barley heavily during this time, up to the limit of the cow's acceptance, so as to secure as conclusive evidence as possible with regard to the cumulative effect of this cereal and this method of feeding on the milk flow. The cow selected for this experiment, a grade Holstein named Hannah, had been in the University dairy herd for a year previous to the trial. She was purchased by the University in July, 1913, was about four years old at that time, and weighed slightly over 1200 pounds. She dropped a bull calf on July 16, shortly after her arrival in the herd. Hannah is a strong, healthy animal; she has always been in the best of health and condition while in the herd, and has repeatedly been placed on experiments which did not interfere with that here outlined. Her feed record for the year prior to the barley feeding is complete up to January 1, 1914, so far as kinds of feeds are concerned. Since that time, the amounts of feed eaten are known for her as well as all other cows in the University dairy herd.

The milk yielded by the cow was weighed throughout the lactation period, and weekly composite samples of the milk were taken and tested for total solids and butterfat. The effect of the grain feeding on the body condition and the general health of the cow was also carefully noted. Table I shows the production and the feed consumed by this cow during five consecutive lactation periods, 1913–18. During the middle three years, 1914–17, she was fed barley as a sole concentrate, and during the first and the last year of the trial mixtures of common grain feeds, the roughage fed throughout the trial being alfalfa hay or green alfalfa, and Indian corn or sorghum silage.

TABLE Ia

PRODUCTION OF HANNAH, 1913–18

Year	Dates of calving	Days in milk	Lbs. milk	Lbs. butterfat	Per cent butterfat	Ave. body weight lbs.	Character of grain feed
1913–14	July 16,'13	274	8,246.2	269.11	3.27	1,231	Mixed
1914–15	May 27,'14	350	12,806.1	432.77	3.37	1,276	Barley
1915–16	June 30,'15	308	11,859.5	373.11	3.15	1,349	Barley
1916–17	June 14,'16	323	9,605.4	315.74	3.29	1,439	Barley
1917–18	July 23,'17	317	9,535.5	325.06	3.41	1,445	Mixed

TABLE Ib

FEED CONSUMPTION BY HANNAH PER LACTATION PERIOD, IN LBS.

Feeds	1913–14*	1914–15	1915–16	1916–17	1917–18	Average 1914–17 (barley only)
Alfalfa hay	.....	4,674	4,551	5,482	4,931	.....
Alfalfa, green	.....	6,836	5,331	2,378	855	.....
Indian corn, green	.....	317	359	.....	195	.....
Indian corn, silage	.....	1,570	6,537	6,564	8,591	.....
Sorghum silage	.....	3,437	.....	.....	1,587	.....
Sudan grass silage	.....	.....	.....	650	.....	.....
Barley	.....	3,059	2,917	2,350	483	.....
Wheat bran	.....	.....	.....	.....	292	.....
Oats	.....	.....	.....	.....	24	.....
Cocoanut meal	.....	.....	.....	.....	336	.....
Dried beet pulp	.....	.....	.....	.....	1,015	.....
Cottonseed meal	.....	.....	.....	.....	46	.....
Total concentrates	.....	3,059	2,917	2,350	2,917	2,775
Average daily grain	.....	8.7	9.5	7.3	6.9	8.5
Feed units, roughage	.....	4,177	4,156	4,283	4,308	4,205
Feed units, concentrates	.....	3,059	2,917	2,350	2,197	2,775
Total feed units	.....	7,236	7,073	6,633	6,505	6,980

* Amounts of feed eaten known only during latter half of lactation period; fed alfalfa (green or hay), corn silage and concentrates (barley, oats, bran, linseed meal, cocoanut meal, in varying mixtures) during the year.

The table shows the dates of freshening during the progress of the experiment; days in milk for each lactation period; production of milk and butterfat, with average percent of fat, body weight, and feed consumed. It will be seen that Hannah's production during the first lactation period on barley was increased by about 4560 pounds of milk and 164 pounds of butterfat over that of the preceding period —an increase of 55 per cent and 61 per cent, for milk and butterfat respectively. This increase was of course primarily due to the heavy grain feeding practiced during this year. Up to March, 1914, Hannah received rough feeds only, alfalfa hay and corn silage, to which a daily allowance of five pounds of mixed grain feeds (barley, oats, linseed meal and cocoanut meal) was added after March 5. During the greater portion of the first year of barley feeding, on the other hand, she received ten pounds of barley daily, and seven to eight pounds during the last four months of the lactation period. While she was offered and ate as much as fifteen pounds of barley daily for a few weeks during the following lactation period, it was found that ten pounds a day was ordinarily her limit, and this amount was rarely exceeded even at the flush of her production when she produced over two pounds of butterfat daily. She remained in milk considerably longer this lactation period than during the preceding year, viz., 350 days, and her body weight was, on the average, forty-five pounds heavier during the barley feeding than while on mixed grain the preceding period.

During the following two lactation periods the feeding of barley as exclusive grain feed was continued; the amount of milk produced during these two periods was somewhat lower than during the preceding year, but considerably above the yield for the mixed grain period, and the same holds true also for the production of butterfat during these periods. If the average production by the cow during the three lactation periods when she was fed barley as sole concentrate be compared with the corresponding averages for the preceding and the following periods when mixed grain was fed, it will be found that her milk production during the barley periods was 2533 pounds, or 28.5 per cent, higher than when she was fed mixed grain, and her average production of butterfat was increased by seventy-five pounds, or 25.3 per cent. Her lactation periods during 1914–17 were thirty-one days (10 per cent) longer, on the average, than during the mixed grain feeding, and she weighed an average of twenty-nine pounds heavier during the intermediate periods than when fed mixed grain rations.

The average yields of butterfat by the cow for each day in milk

during the five lactation periods, 1913–18, were .98, 1.23, 1.21, .98, and 1.03 pounds, the average for the barley period being 1.14 pounds, which is 13 per cent above the average for the mixed grain period. Since the amount of grain and roughage eaten during the first lactation period, 1913–14, is not known, no definite comparison can be made between the feed consumption and the dairy production of the cow during the five-year period. However, as grain was fed only during the latter part of the first lactation period, the amount of mixed grain eaten, and the total or daily feed consumption must have been considerably lower this period than during the first year of barley feeding. The average amount of barley eaten daily for the periods 1914–17 was 8.5 pounds, against 6.9 pounds of mixed grain the following year. The average number of feed units in the barley rations was 6980, or 7.3 per cent above that furnished in the last mixed grain period, 1917–18. It seems evident, therefore, that the increase in production during the barley periods, as compared with the yields on mixed grain feeding, came largely as a result of the heavier rations fed, especially of grain, during the barley periods.

There is nothing in the results obtained on the experiment with this cow that would indicate that an exclusive or even a heavy, long-continued feeding of barley has any deleterious influence on the milk secretion of the cow; on the contrary, the production was greatly increased on barley feeding; her lactation periods were about a month longer, on the average; she weighed heavier when fed barley than when receiving mixed-grain rations, and she was in perfect health and maintained an excellent appetite throughout the whole feeding period. The effect of the exclusive barley feeding was therefore beneficial in every respect.

EXPERIMENT WITH TWO PURE-BRED COWS

Similar data to those given in the preceding pages have been obtained during the past three years for complete lactation periods for two pure-bred cows, one Jersey and one Holstein, and for a considerable number of cows for a fraction of a lactation period. The experiments with the former cows were not conducted primarily for the purpose of trying out the effect of exclusive barley feeding on their milk production; the cows on this experiment had hardly come up to the expectations of this class of dairy animals and they were changed to a barley-alfalfa-silage diet to ascertain whether this would tend to render them less profitable dairy producers than they had proved under the system of feeding ordinarily practiced in the dairy herd.

The cows placed on this experiment were Roxey Mercedes Queen 2d, 144605 (Holstein) and University Marigold, 282343 (Jersey).

Roxey was purchased by the University in 1911 as a two-year-old; she produced 4694.5 pounds of milk and 192.91 pounds of fat (4.11 per cent) during her first year in the University dairy herd; her

TABLE IIA

PRODUCTION OF PURE-BRED COWS FED BARLEY, 1915–17

Year	Dates of calving	Days in milk	Lbs. milk	Lbs. butterfat	Per cent butterfat	Ave. body weight lbs.	Character of grain feed
	Roxey Mercedes Queen 2d, 144605						
1913–14	Dec. 23,'13	351	9,813.2	380.25	3.87	1,280	Mixed
1915	Jan. 8,'15	335	7,736.9	308.34	3.98	1,249	Barley
1916	Jan. 1,'16*	362	9,027.2	342.96	3.80	1 338	Mixed
1917	Mar. 3,'17	270	7,243.1	296.28	4.09	1,361	Mixed
	University Marigold, 282343						
1914–15	Apr. 28,'14	462	6,509.5	356.38	5.47	883	Mixed
1915–16	Sept. 19,'15	315	4,332.2	252.80	5.97	911	Barley
1916–17	Aug. 29,'16	296	4,197.7	254.09	6.05	970	Mixed

* Aborted.

TABLE IIB

FEED CONSUMPTION, PER LACTATION PERIOD, IN POUNDS

	Roxey				Marigold		
	1913–14	1915	1916	1917	1914–15	1915–16	1916–17
Alfalfa hay	4,424	4,144	7 253	4,416	5 862	5,773	4,843
Alfalfa green	8,111	7,509	3,055	2,876	11,705	1,701	1,727
Indian corn, green	387	934	.....	194	165	575	.....
Indian corn, silage	2,487	1,125	5,208	4,352	1,430	4,568	5,287
Sorghum silage	.....	2,648	.....	432	2,441	.....	1,260
Oat silage	.....	1,575	.....	.....	1,540	.....	.....
Sudan grass silage	.....	.....	670	.....	.....	.....	650
Green barley	1,690	.....	.....	.....	.....	.....	.....
Roots	412	.....	.....	.....	.....	.....	.....
Wheat bran	879	.....	198	164	572	.....	192
Barley	1,106	2,157	471	364	2,091	1,711	253
Oats	437	.....	.....	29	253	.....	5
Milo	.....	.....	46	.....	.....	.....	.....
Linseed meal	161	.....	11	.....	108	.....	.....
Cocoanut meal	117	.....	200	476	104	.....	377
Dried beet pulp	692	.....	278	1,036	210	.....	575
Cottonseed meal	.....	.....	18	66	.....	.....	54
Total grain feed	3,392	2,157	1,222	2,135	3,338	1,711	1,456
Average per day	9.7	6.4	3.4	7.9	7.2	5.4	4.9
Feed units, roughage	3,868	3,890	5,042	3,437	5,524	3,962	3,867
Feed units, concentrates	3,392	2,157	1,222	2,135	3,337	1,711	1,456
Total feed units	7,260	6,047	6,264	6,572	8,862	5,673	5,323

production during subsequent years is given in table II. She was admitted to the Advanced Register of the Holstein-Friesian Association on the basis of an official seven-day record, January 5 to 12, 1914, of 339.2 pounds of milk and 13.540 pounds butterfat (A. R. O., No. 26364). Roxey was of a blocky build and was a poor type of a Holstein, in spite of her good seven-day record; as she proved an uncertain breeder she was sold for beef in December, 1917, after a lactation period of only 270 days, during which she produced 7243 pounds of milk and 296.3 pounds butterfat.

University Marigold, No. 282343, was bred by the University of California (born September 8, 1911). She has an official record of 5566 pounds of milk and 319 pounds butterfat for the year ending April 29, 1915 (mixed-grain ration. See table II). She did not get in calf after freshening August 17, 1917, and was sold for beef in April, 1918.

The results presented in table II will only be discussed here as regards their bearing on the effect of barley feeding on the production of the cows. It will be noted that the production of these cows during the periods when barley was fed as exclusive grain feed did not show a similar improvement in production over the mixed grain periods as in the case of the grade cow, Hannah. Roxey produced about 18 per cent less milk and 15 per cent less butterfat during the barley periods than on the mixed grain rations, the corresponding figures for Marigold being 19 per cent and 17 per cent less. The average daily production of butterfat during the barley periods was 9 per cent and 2 per cent lower than when mixed grain was fed, for Roxey and Marigold, respectively.

The amounts of barley fed these cows were considerably smaller than in the case of Hannah, viz., on the average, 6.4 pounds daily for Roxey and 5.4 pounds for Marigold, and the rations fed during the barley periods contained in both cases less grain and less total feed materials than during the corresponding mixed-grain periods. The decreased dairy production by the cows during the former periods is, therefore, only what might be expected. The length of the lactation periods when barley was fed was fully normal in the case of both cows.

The evidence furnished by the trials with these cows at first thought might be taken to indicate that the feeding of barley as sole grain feed was responsible for the decreased dairy production during the barley periods. If the conditions of the trials and the relation of feed consumption to production be studied, however, it will be readily seen that such a conclusion is not warranted and that barley feeding appar-

ently did not have any undesirable effect on these cows any more than in the case of Hannah, either in so far as the production or the health and thriftiness of the animals are concerned.

FEEDING BARLEY DURING BRIEF PERIODS

As previously stated, a number of cows in the University dairy herd have been fed barley as sole concentrate during brief periods, mostly five weeks in each case, during the last two years. It is of interest to determine in how far the substitution of barley for mixed grain in the rations of the cows affected the production and body weights of the cows. The dairy records for these cows have therefore been compiled, the data for the weeks when barley was fed being compared with the averages of the corresponding preceding and following weeks when mixed grain was fed. None, or but slight, changes occurred in the kinds or amounts of roughage fed during these periods. The results of these compilations are presented in table III.

A study of the data presented in the table will disclose the fact that the amounts of milk produced on the barley rations were higher than those produced on the mixed-grain rations in the case of twelve

TABLE III

PRODUCTION BY COWS FED BARLEY OR MIXED GRAIN DURING CORRESPONDING PERIODS

	Fed barley as exclusive concentrate					Fed mixed grain			
Name of cow	Days from calving	Lbs. milk	Lbs. fat	Average per cent fat	Body weight lbs.	Lbs. milk	Lbs. fat	Average per cent fat	Body weight lbs.
Korndyke	358	487.7	19.04	3.9	1,480	478.3	18.58	3.9	1,447
Whittie	105	793.8	28.99	3.7	997	763.5	27.27	3.6	998
Bess 2d	96	900.5	34.53	3.8	1,227	844.9	32.41	3.8	1 215
Blackie	228	284.6	13.62	4.8	1,288	264.4	11.48	4.3	1,276
Helen	130	718.1	26.48	3.7	1,433	774.1	28.66	3.7	1,410
Lulu	248	561.5	23.12	4.1	1,172	569.7	23.69	4.2	1,179
La Polka	195	539.6	19.32	3.6	1,371	528.4	19.86	3.8	1,395
Queen	280	610.9	20.15	3.3	1,448	649.9	20.64	3.2	1,449
Roanee	137	881.2	31.66	3.6	985	800.7	28.33	3.5	963
Colantha	293	394.4	13.34	3.4	963	375.7	12.50	3.3	948
Peggy	86	1,274.2	46.53	3.7	1,009	1,241.8	42.13	3.4	1,001
Woodland	.....	613.2	27.62	4.5	1,157	577.0	27.02	4.7	1,164
Bess Lass	51	542.6	18.76	3.5	1,045	486.9	16.50	3.4	1,031
Mermaiden 2d	191	513.3	24.13	4.7	791	468.5	20.37	4.3	790
Fern	136	325.8	16.93	5.2	941	317.8	16.34	5.1	957
Totals and averages	181	9,441.4	364.22	3.86	1,154	9,141.6	345.78	3.78	1,148
Difference		+299.8	+18.44	+ .08	+6	.....	.....	.....	.....

cows, and the lower in the case of three cows; the amounts of butterfat were higher in eleven cases and lower in four cases, and the average body weights of the cows were higher in nine cases and lower in six cases; finally, the percentages of fat were higher during the barley periods in nine cases and lower in three cases than during the mixed-grain periods (no appreciable change in three cases). Considering the average data for all fifteen cows, it will be seen that there was an increase of 3 per cent in the total amount of milk produced, of 5 per cent in the amount of butterfat produced, and of 6 pounds in the body weights of the cows, on the barley rations as compared with the mixed-grain rations. The average fat content of the milk produced on the former rations was, furthermore, slightly improved (.08 per cent) over that of the milk produced when the cows were fed mixed grain.

These average differences are not very marked; only in the case of two cows was the milk production improved by more than 10 per cent during the barley feeding over that of the preceding and following mixed-grain periods, and the fat production was increased by more than 10 per cent during the former periods in the case of four cows. The conclusion might be justified under these conditions that the slight improvement in production in the case of these fifteen cows came as a result of substituting barley for mixed grain, but it is also possible, in fact more likely, that the differences in production observed may lie within the limits of experimental errors in trials of this kind, and that they cannot therefore be interpreted to indicate a higher nutritive effect of rolled barley above that of the mixtures of standard concentrates fed to these cows. Whichever explanation is accepted, it is very clear, however, that the results of the last trials furnish positive evidence that barley has no tendency to decrease the milk production of the cows in comparison with that secured by feeding similar amounts of common grain mixtures, and that the feeding of barley to dairy cows is not accompanied by deleterious effects of any kind. Like the testimony previously presented by the five-year trial with the grade cow, Hannah, and by the trials with the two pure-bred cows, the results obtained in these short-period trials show that barley is an excellent feed for milch cows, and that when fed with alfalfa, or with alfalfa and silage, the production of the cows is at least equal to that secured on rations made up of similar rough feeds and mixtures of standard grain feeds, like wheat bran, oil meals, beet pulp, etc.

In several of the trials reported, somewhat better results were obtained during the barley periods than when mixed concentrates were fed; in nearly all of these cases the total amounts of feed eaten by the cows in the former rations were, however, larger than in those of

the latter. The data secured in the trials can hardly be interpreted to show that barley is a more efficient component of rations for dairy cows than similar amounts of mixed standard grain feeds; experience has taught dairy farmers that variety is a very desirable quality in the feed ration, and tends to insure a good, healthy appetite, and a large dairy production.

FEEDING VALUE OF BARLEY

There is every reason to consider barley a most valuable stock feed. It is the common bread-grain in northern European countries, and its high nutritive value for man and beast is generally recognized there as elsewhere. It is one of the standard grain feeds for dairy cattle and other farm animals in the Scandinavian countries and is also used as a feed for farm stock, including poultry, in many other parts of Europe and in northern Africa. Barley is the common grain fed to the Arab horses, among others—a breed noted for its vigor and endurance. Without entering into a discussion of the constitution of the various feed components in the various cereals, we may say that barley does not greatly differ from other cereal grains in either chemical composition, digestibility or nutritive effects, as will be seen from the following table. The figures given in the table show that, so far as digestible nutrients or net energy values are concerned, this cereal ranks with Indian corn, rye and wheat.

TABLE IV

CHEMICAL COMPOSITION, DIGESTIBLE NUTRIENTS, AND ENERGY VALUES OF CEREAL GRAINS, IN PERCENT

	Moisture	Protein	Fat	Fiber	Nitrogen-free extract	Ash	Digestible		Net energy values, therms
							Protein	Carbo-hydrates and fat	
Barley	10.8	12.0	1.8	4.2	68.7	2.5	9.4	75.9	89.9
Indian corn	10.6	10.3	5.0	2.2	70.4	1.5	7.8	76.5	85.5
Oats	10.4	11.4	4.8	10.8	59.4	3.2	10.7	62.3	67.6
Rice, rough	9.6	7.6	1.9	9.3	66.7	4.9	4.7	68.4	77.3
Rye	8.7	11.3	1.9	1.5	74.5	2.1	9.5	72.1	93.7
Sorghum grain	12.7	9.2	3.4	2.0	70.8	1.9	7.5	72.0	89.8
Wheat	10.4	12.5	2.2	1.8	71.2	1.9	9.3	69.8	91.7

It is sound dairy economics to feed crops grown on the farm as far as possible. The expense of hauling, middlemen's profits, etc., is thus saved and one is largely independent of fluctuating market conditions. The fertilizer value of barley is furthermore saved by this method of disposing of the crop and the danger of depleting the fertility of the land is thus decreased. For these reasons, as well as

because of the fact that barley has been shown to be an excellent dairy feed, its use in rations for dairy cows is to be recommended when its market value has not been artificially raised through a demand for the crop for other purposes than stock feeding.

* The explanation of the belief of some farmers that the feeding of barley tends to dry up milch cows is probably to be sought in the fact that such a result has frequently come when cows have been turned out on barley stubble, or fed coarse barley hay only, with no additional feed. The amount of feed they are thus able to obtain, especially on stubble pasture, is not, as a rule, likely to furnish sufficient nutriment for the maintenance of a fair dairy production, and a decrease in the milk flow naturally results, along with a gradual drying up of the cows. The barley is blamed, while it is the system of feeding that is responsible for the result observed. Milch cows producing a good mess of milk cannot be expected to pick up sufficient feed to maintain their production on barley stubble alone, but fed alfalfa hay in addition, or better still, alfalfa and some succulent feed, like silage or roots, they will give good returns for the feed that they find in the stubble field.

In view of the results and discussions presented in the preceding, there is every reason to utilize barley for feeding dairy cows when it is not needed for human food and whenever its price is not too high in comparison with other concentrates to make it an economical stock feed. During the past two seasons the insufficiency of the wheat supply has made it necessary for our people to use substitutes in bread making and for other household purposes, and barley was the most common and best known substitute available. Under normal conditions of the grain market, however, and when the attention of the civilized nations shall again be turned toward peaceful pursuits, the main market for barley in this country will again be for stock feeding, unless a demand for brewing barley should be reopened. In either case, barley growers may look to our stockmen to use a very large proportion of their crop, and it should be kept in mind that this cereal is well adapted for feeding different classes of farm animals, including dairy cattle.

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* It is believed by some farmers that feeding smutty barley will tend to dry up milch cows. There is, however, no definite evidence to this effect, although the danger of feeding considerable amounts of smutty grain to any kind of stock, and especially to pregnant females, is generally recognized.